DEFLECTION

Beam self weight

$$\Delta_g = \frac{5 * w_{beam} * L^4 * 1728}{384 * E_{ci} * I_g}$$

$$E_{ci} = 57\sqrt{f'_{ci}}$$

f'_{ci} = girder concrete strength at release (ksi)
I_g = Moment of Inertia of girder (in^4)
L = span length (ft)
W_{beam} = beam dead load (kips/ft)

Non-composite Dead Loads

$$\Delta_{SDL} = \frac{5 * w_{SDL} * L^4 * 1728}{384 * E_c * I_g} \qquad E_c = \frac{E_{ci}}{0.85}$$

Composite Dead Loads

$$\Delta_{CDL} = \frac{5 * w_{CDL} * L^4 * 1728}{384 * E_c * I_c}$$

I_c = Composite Moment of Inertia (in^4)

Prestressing Force at Transfer

For 2 point harping; $\Delta_p = \frac{P_i}{E_{ci} * I_g}\left(\frac{e_{mid} * L^2 * 144}{8} - \frac{e_{mid} * a^2 * 144}{6} + \frac{e_{end} * a^2 * 144}{6}\right)$

For straight strand; $\Delta_p = \frac{P_i * e * L^2}{8 * E * I_g}$

$P_i = P_0 - f_{ES}*A_{ps}$
f_u = strand ultimate strength (ksi)
A_{ps} = total area of strand (in^2)
$P_0 = 0.75*f_u*A_{ps}$

a = distance from end of girder to harp point (ft)

$e_{end} = Y_b - cg_{end}$ $\qquad$ Y_b = centroid of girder from bottom (in)

$e_{mid} = Y_b - cg_{mid}$ $\qquad$ cg = strand center of gravity (in)

$$f_{ES} = \frac{\frac{P_0}{A_g} + \frac{P_0 * e_{mid}^2}{I_g} - \frac{M_{girderDL} * e_{mid} * 12}{I_g}}{\frac{E_{ci}}{E_{ps}} + \frac{A_{ps}}{A_g} + \frac{A_{ps} * e_{mid}^2}{I_g}}$$

At Release:

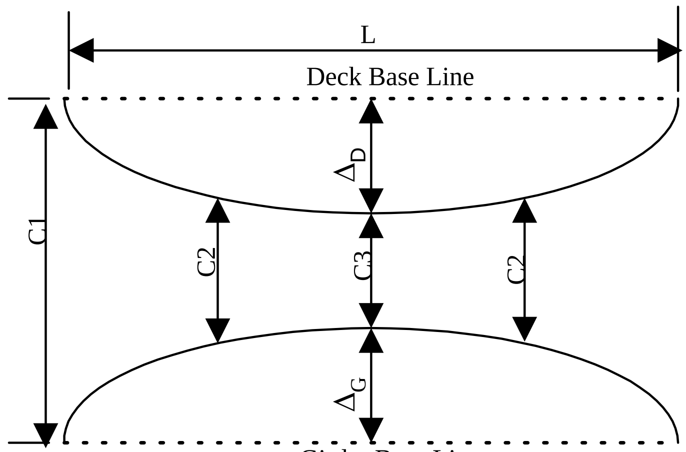
$$\Delta_{release} = \Delta_g + \Delta_p$$

At Slab Placement:

$$\Delta_{erection} = 1.65 * \Delta_g + 1.55 * \Delta_p$$

CAMBER STRIP

Both the deck and girder profiles can be assumed to be parabolic curves, either above or below a base line. The base line for the deck is a straight line between the point at the beginning of the span to the point at the end of the span on the underside of the deck. The base line for the girder is the straight line between the point at the beginning of the span to the point at the end of the span on the top of the girder.



C1 = Camber strip thickness at ends of girder
C2 = Camber strip thickness at ¼ point of girder
C3 = Camber strip thickness at mid-span of girder

Δ_D and Δ_G must be first calculated to determine C1, C2, and C3. A positive value for Δ_D or Δ_G indicates the profile is above its respective base line.

$$\Delta_D = \Delta_{VC} - \Delta_{HC}$$

Δ_{VC} = Vertical curve effect (inches)
Δ_{HC} = Horizontal curve effect (inches)

$$\Delta_{VC} = \frac{1.5 * G * L^2}{VC}$$

G = algebraic difference in profile tangent grades (ft/ft)
+ for crest vertical curve
- for sag vertical curve
VC = vertical curve length (ft)
L = girder span length (ft)

$$\Delta_{HC} = \frac{1.5 * s * L^2}{R}$$

S = super-elevation rate (ft/ft)
R = radius of horizontal curve (ft)
L = girder span length (ft)

$$\Delta_G = 1.55\,\Delta_p - 1.65\,\Delta_g - \Delta_{SDL} - \Delta_{CDL}$$ (All values are absolute values)

If $\Delta_D > \Delta_G$; camber strip thickest at mid-span (Δ_D and Δ_G are algebraic values)

$$C_1 = F + s * \frac{W_f}{2}$$

F = minimum fabrication/construction tolerance value; ½" for spans up 80' & 1" for spans over 80'.
S = super-elevation rate (ft/ft)
W_f = girder top flange width (inches)

$$C_2 = C_3 - \frac{C_3 - C_1}{4}$$

$$C_3 = C_1 + \Delta_D - \Delta_G$$

If $\Delta_G > \Delta_D$; camber strip thickest at ends (Δ_D and Δ_G are algebraic values)

$$C_3 = F + s * \frac{W_f}{2}$$

$$C_1 = C_3 + \Delta_G - \Delta_D$$

$$C_2 = C_3 + \frac{C_1 - C_3}{4}$$

If $\Delta_G = \Delta_D$;

$$C_1 = C_2 = C_3 = F + \frac{s * W_f}{2}$$